International Conference on Opportunities and Challenges for Water Cooled Reactors in the 21st Century
27-30 October 2009, IAEA, Vienna, Austria

Nuclear Power Plant Life Management

Integrating safety and economics - EU networking

P. Contri, B. Elsing
Presented by Christiane.Bruynooghe
@ec.europa.eu

http://www.jrc.ec.europa.eu/

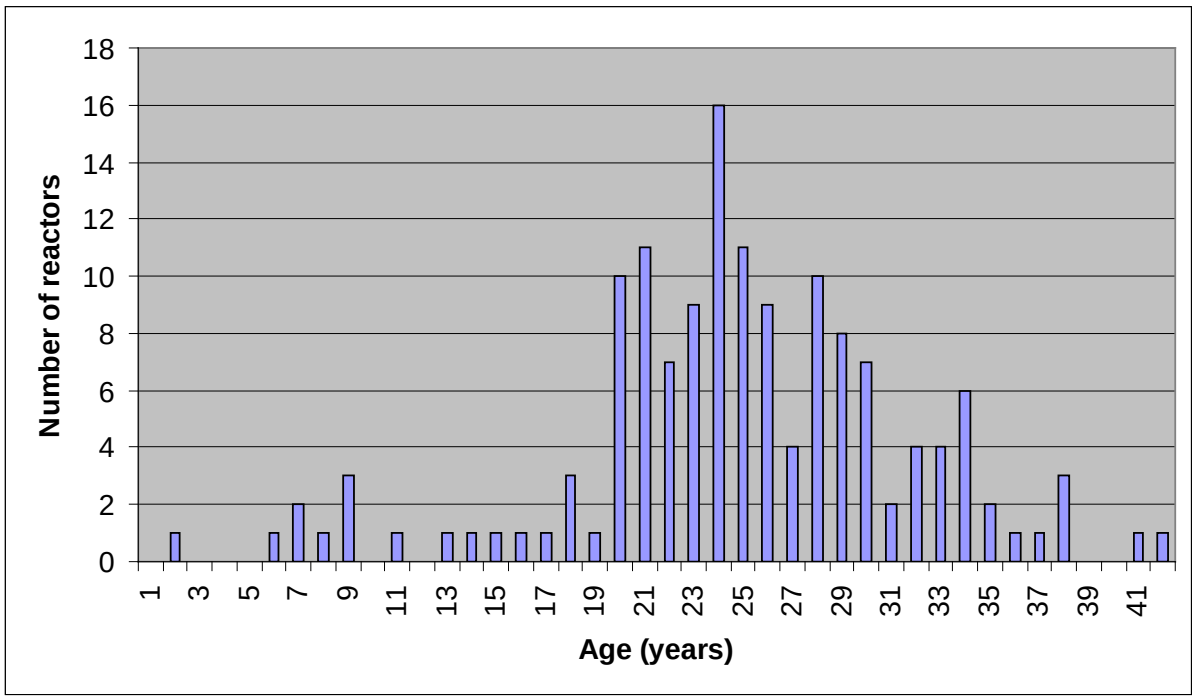
The reference EU background scenario

1. The generic trend towards the **extension of the operating life** of the existing plants. Such life extension requires a detailed review of the original design assumptions, also reflected into current **maintenance practice**, and the continuous monitoring of the component reliability in order to support a suitable trend of the safety evaluation beyond the design life.

2. The **open electricity market**, which is going to be a reality in most of the European Countries in few years. Such economical and financial framework demands for significant reduction of the generation **costs**, very strict investment planning, outsourcing, controlled reliability of the equipment and components (incl. obsolescence) and therefore for reliable indicators of the effectiveness of the maintenance programme

Environment that triggers interest in PLiM:

- Electricity needs between time of end of operation and new plants in EU27, also taking into account raise in the non nuclear-non CO2 contribution speaks for plant life extension consideration (Investigation of the power plant management in view of Long Term Operation, beyond the initial 30-40 years scope



It is a fact that new global approaches have been triggered in recent years by a combination of factors such as:

- The generic trend towards **plant life extension** beyond the original design life, in order to exploit the plant design at the maximum level
- The **market economy**, which is pushing for a more stringent management of the economic assets
- The detection of significant **ageing phenomena** which were challenging the original design assumptions
- The need for preservation of the **human knowledge** in time, particularly in Countries with growing opposition to nuclear expansion
- The more stringent **regulatory requirements** in terms of **safety assessment and monitoring**
- The need for preparing for **decommissioning** phase also during plant life

PLiM is an organising tool with close relationship and integrating function for technical programmes:

- **Maintenance Surveillance and Inspection** (MS&I)
- **Risk-Informed In-Service Inspection** (RI-ISI)
- **Ageing Management**
- **Component obsolescence** and conformity assessment
- **Knowledge management**
- **Human factors & Maintenance**

JRC seeks to favour networking in these **technical fields**

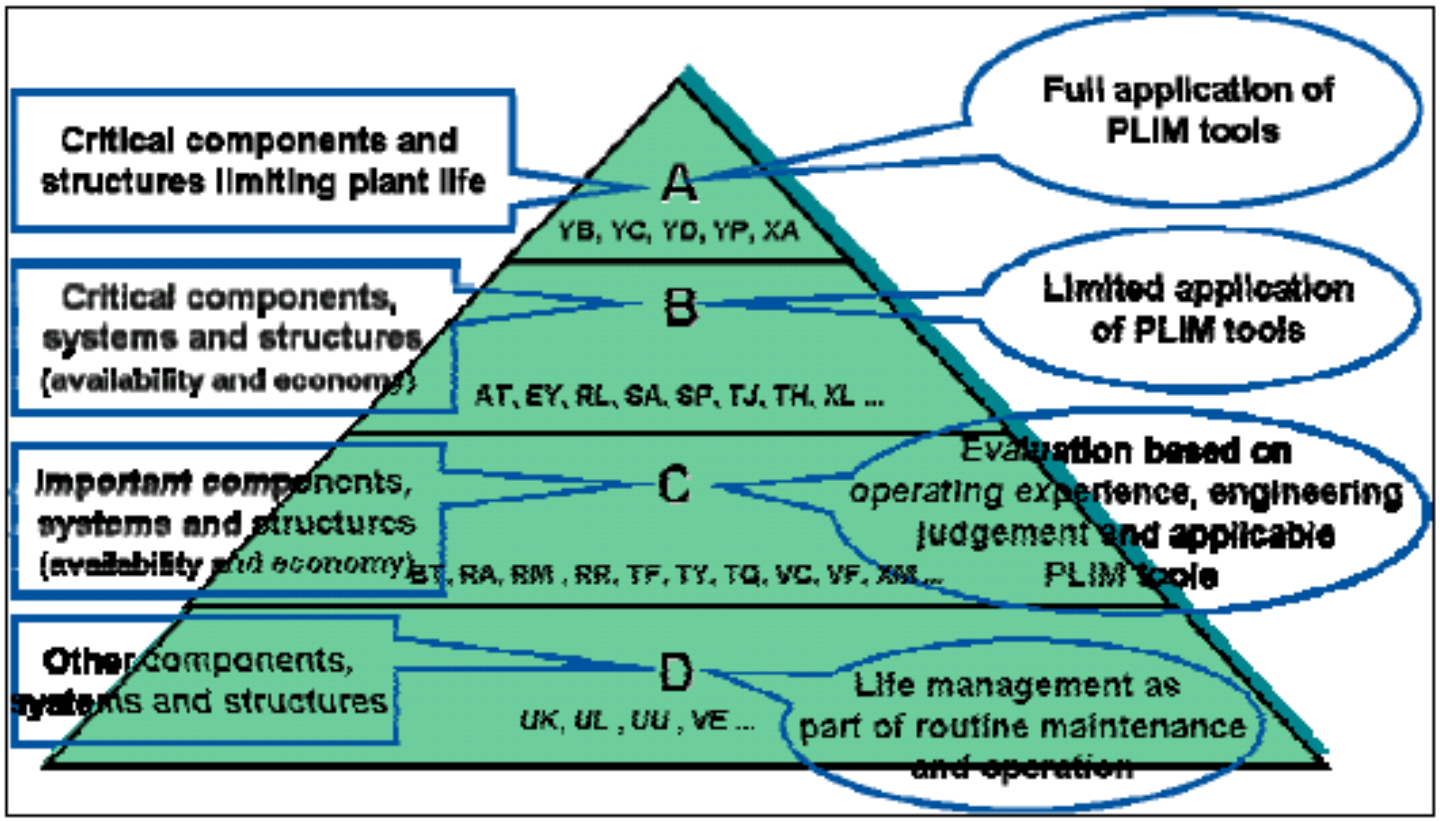
JRC has launched a study to learn from various PLiM in EU NPPs

PLiM approaches may differ but all recognise the hierarchy between the related programs:

1. Technical areas
   - Component integrity: maintenance optimisation, RI-ISI, Maintenance Surveillance and Inspection
   - Ageing management: component degradation anticipation

2. Management strategies addressing:
   - Organizational issues
   - Spare part management
   - Staff ageing/training
   - Component obsolescence
   - Operational experience feedback, mainly on component integrity and maintenance issues

PLiM approaches all apply a grading of MS&I tasks codified through a formal component classification in relation to PLiM: critical and non critical component for continued safe and efficient operation of the plant.



Ex for MS&I strategy:

Class A: full scope monitoring and analysis of the degradation

Class B: condition based MS&I

Class C: preventive (time-based) MS&I

Class D: run to failure

Ex. From Loviisa

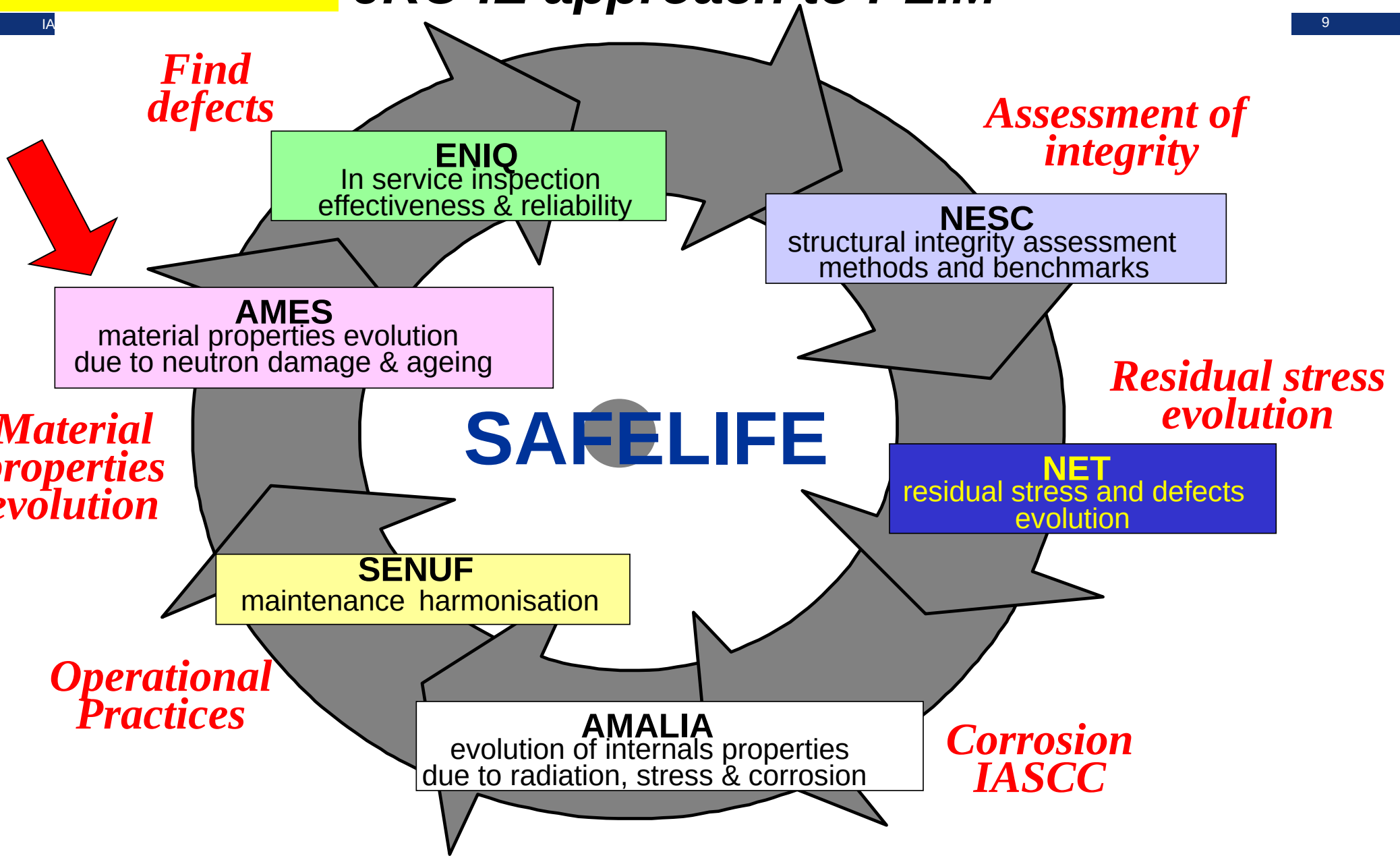
Component classification in relation to PLiM is quite heterogeneous among the countries as it mixes up components, systems and special equipment. This is also true (heterogeneity) for the overall PLiM system in force at the different NPPs.

In contrast it is important to promote harmonized approaches in the scope of PLiM, in the technical related areas and in some organisational issues.

Networks: **ENIQ** , **SENUF** (field oriented)

APSA, **NULIFE** (research oriented)

Integrated JRC-IE approach to PLIM



European Network for Inspection and Qualification (ENIQ)

A utility driven network on the subject of in-service inspection (ISI) by non-destructive testing (NDT)

Utilities joined together by a club-type agreement

ENIQ is working towards a harmonized European approach on reliable and effective ISI

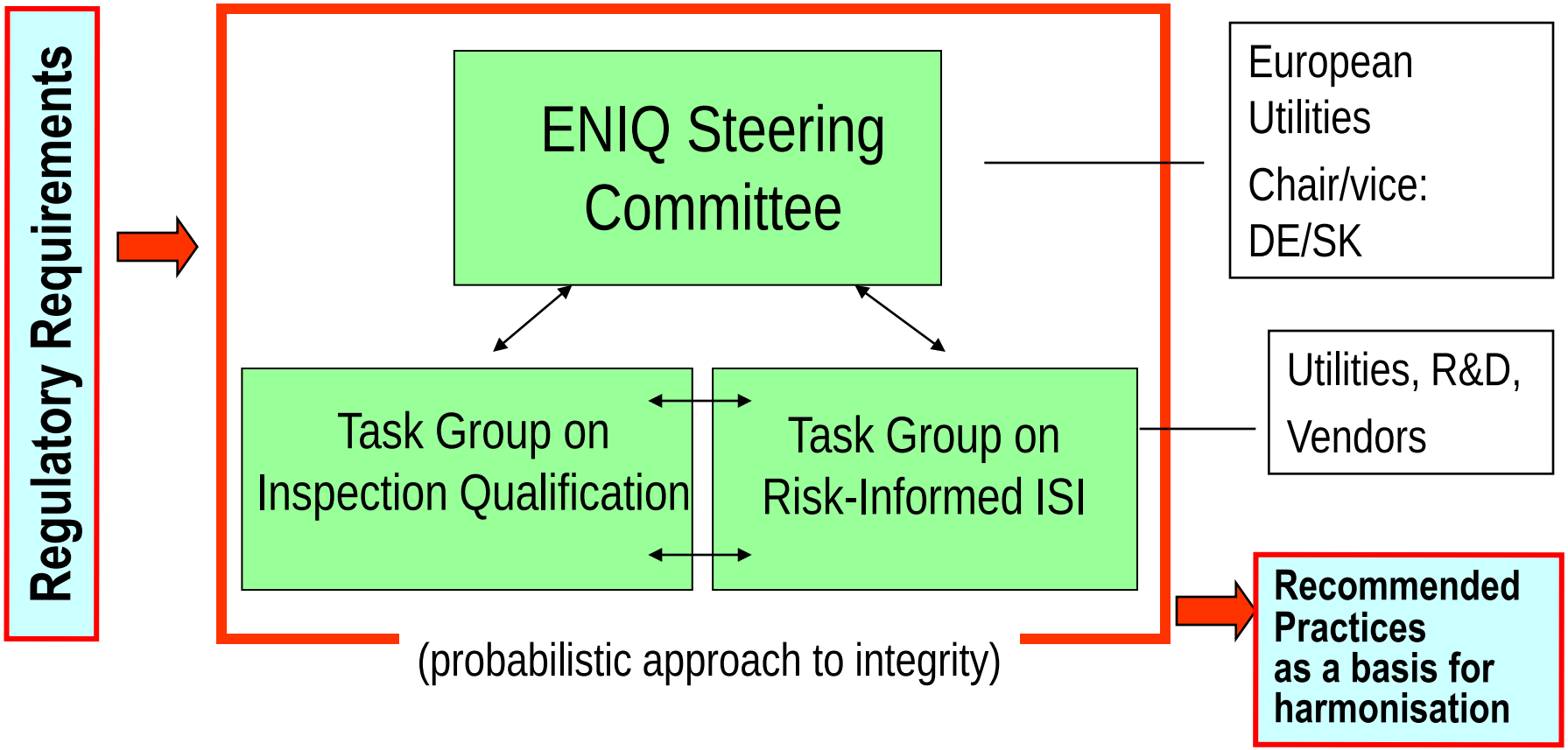
More specifically, ENIQ is working on

Inspection Qualification (IQ)

Risk-Informed In-Service Inspection (RI-ISI)

ENIQ
EUROPEAN NETWORK FOR INSPECTION AND QUALIFICATION

Towards a Harmonisation of Codes & Standards at a European Level



40+ active members: UK, FIN, SE, DE, BE, FR, ES, CZ, SK, HU, CH (COG, IAEA, EPRI)

ENIQ Task Group Qualification – Ongoing Work

Revision of Older and Development of New Recommended Practices

- Revision of Recommended Practice 2 on the strategy and contents for Technical Justifications (TJ)
- Revision of Recommended Practice 5 on guidelines for the design of test pieces and conduct of test pieces trials
- New Recommended Practice 10 on personnel qualification
- Report outlining the ENIQ qualification methodology for non-NDE experts
- Discussion document on the mutual recognition of qualification processes between countries

ENIQ
EUROPEAN NETWORK FOR INSPECTION AND QUALIFICATION

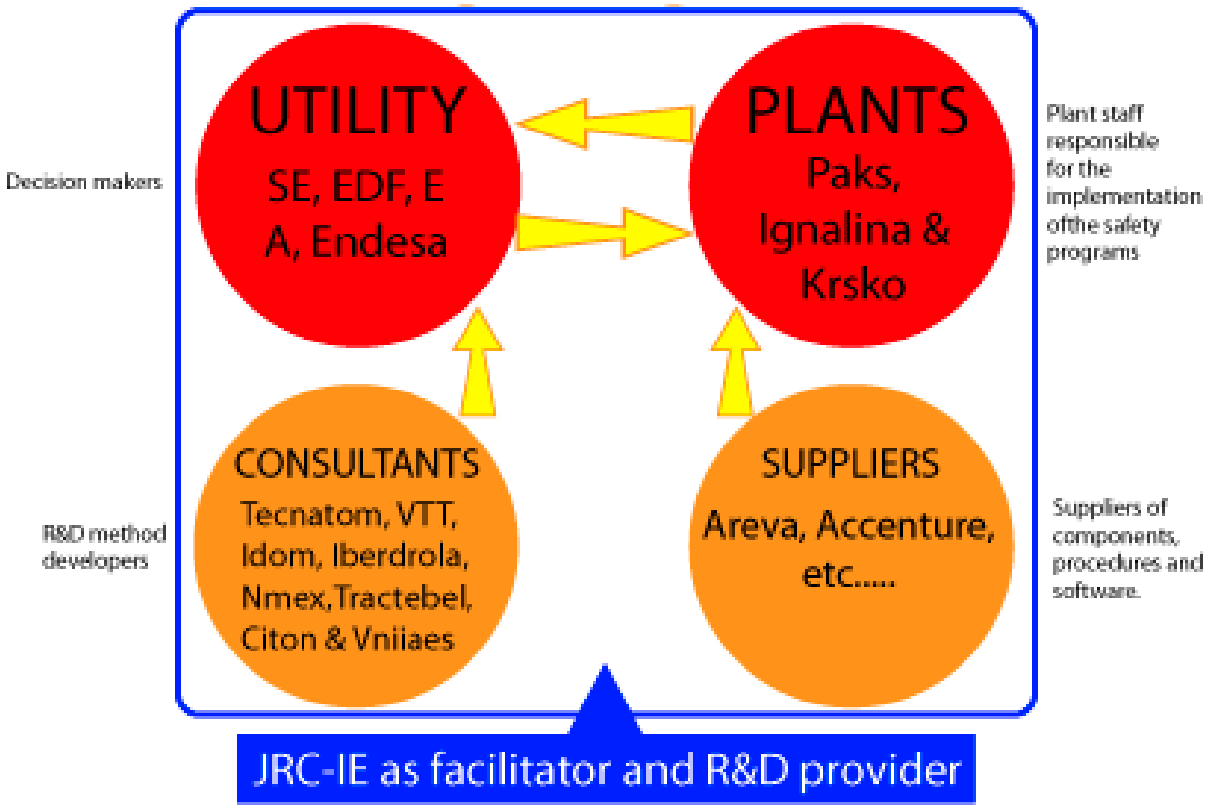
ENIQ Task Group Risk – Ongoing Work

Production of Recommended Practices and Supporting Technical Documents

- Discussion Document concerning the magnitude of risk reduction that is reasonable to achieve through ISI
- Document on RI-ISI feedback and updating
- Guidance Document regarding how inspection targets are set, following the selection of ISI sites
- Guidance Document on different ways to produce PoD curves for ISI

ENIQ
EUROPEAN NETWORK FOR INSPECTION AND QUALIFICATION

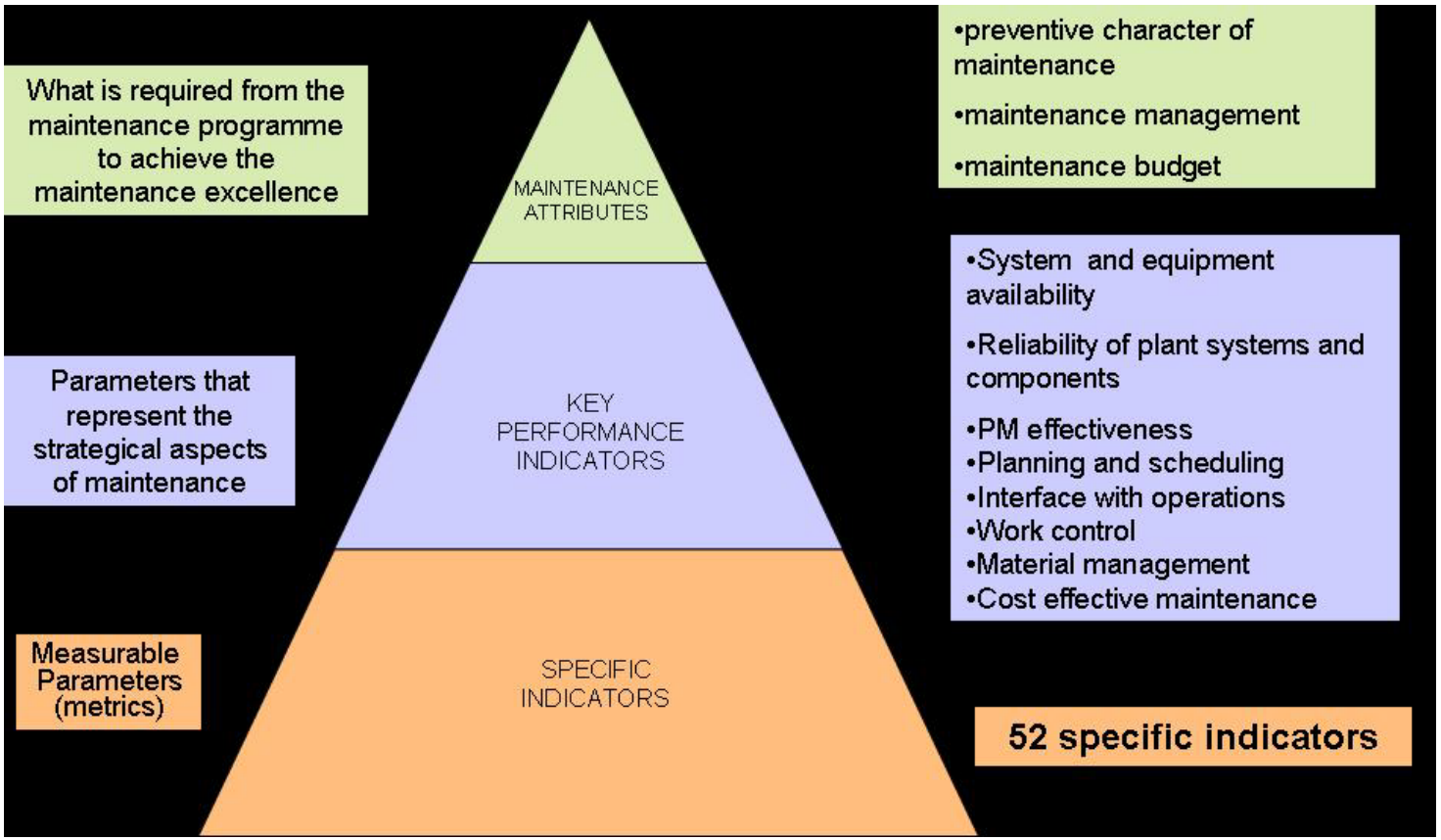
The SENUF Network was founded in 2003



objectives:

- Review and identification of the open maintenance issues
- Promote well designed maintenance plans for systems, structures and components
- Support the implementation of advanced maintenance approaches
- Evaluate advanced risk informed maintenance approaches, and provide assistance on its implementation
- Maintain a database on operation experience in relation to maintenance

Monitoring of Maintenance Performance

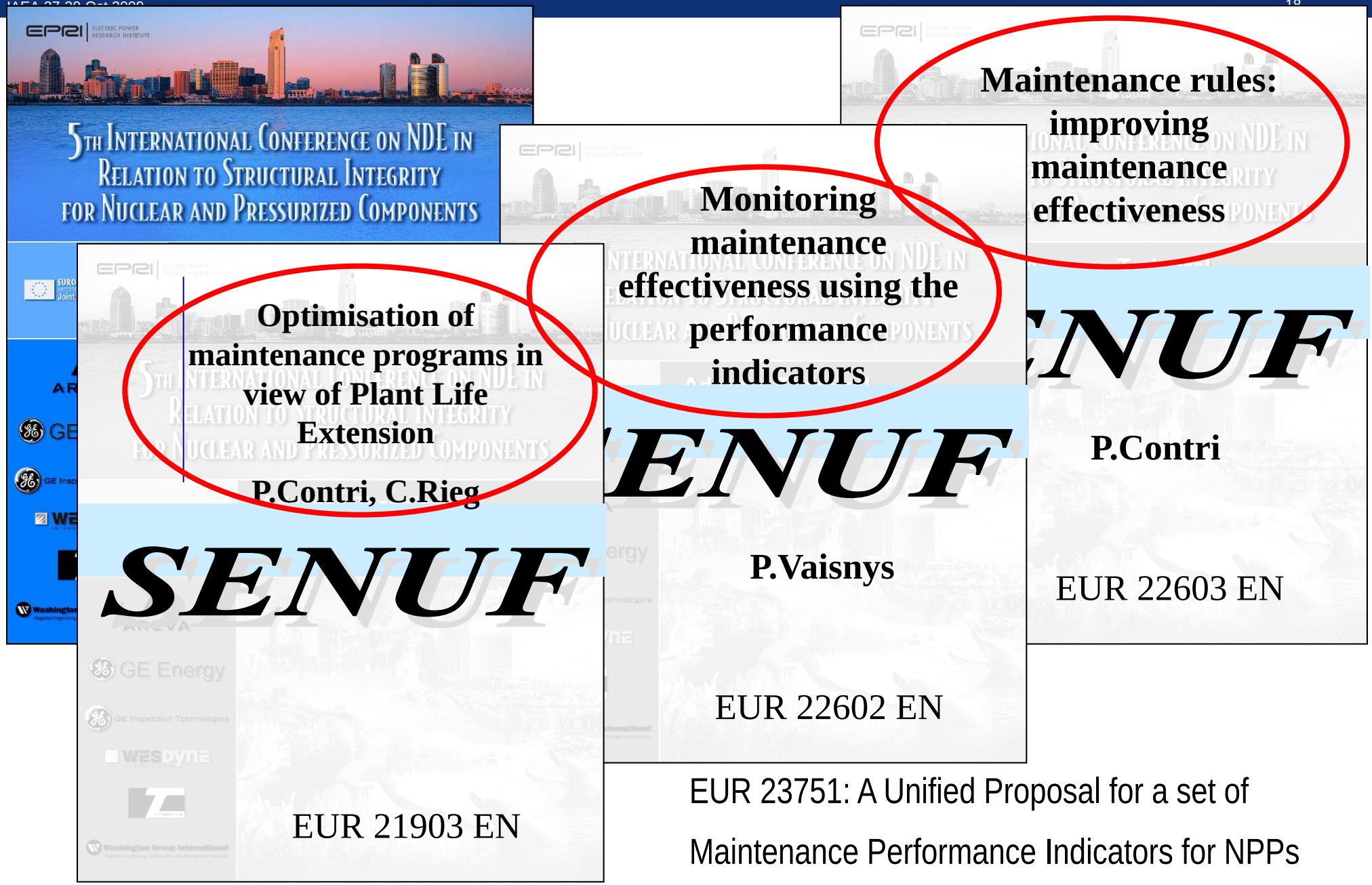


The maintenance performance indicators structure is expanded until the level of easily measurable quantitative metrics

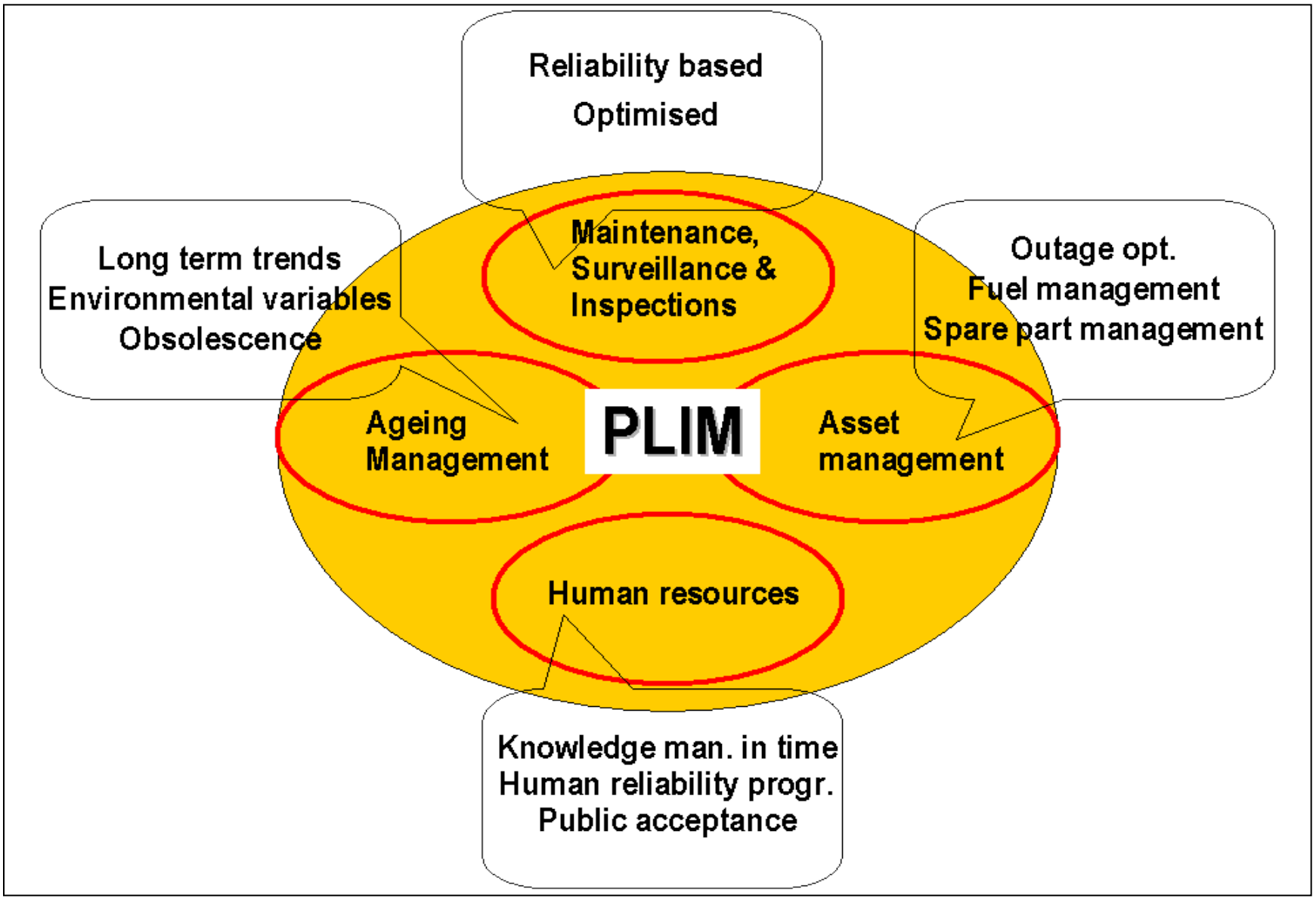
Other Work packages:

- **Develop outage optimization techniques. Address the use of PSA, on-line maintenance, quality of maintenance works.**
- **Benchmarking of optimised approach to maintenance. Equipment reliability approaches, PLiM models, asset management.**
- **Analysis Management of spare part and component obsolescence control support tools**
- **Outsourcing, contracting: qualification of contractors, supervision of contractors by the utility personnel, comparison of available experience, recommendations.**
- **Training of maintenance personnel. Ageing workforces, knowledge management in relation to maintenance. Link with safety**

R&D products



EUR 23751: A Unified Proposal for a set of Maintenance Performance Indicators for NPPs


Reliability based
Optimised
Long term trends
Environmental variables
Obsolescence
Maintenance,
Surveillance &
Inspections
Outage opt.
Fuel management
Spare part management
Ageing
Management
PLIM
Asset
management
Human resources
Knowledge man. in time
Human reliability progr.
Public acceptance

Summary of priorities

1. Address PLIM as a program: combination of technological, economic, regulatory, and knowledge management issues. Integrate safety issues with component replacement policy, management of spare parts, asset management methods and power uprating programs. Develop a generic program structure with example.

2. Develop suitable sets of **indicators** for PLIM effectiveness and guidelines for their improvement, with special emphasis to maintenance, ISI and AM.

3. Suggest suitable **managerial** structures at the plant/utility level. Suggest managerial practices for contractor management and control.

4. Address the **human related issues** in PLIM and suggest approaches for reduction of the events related to maintenance

Summary of priorities

5. Consolidate the **degradation mechanism list** and set a mechanism for a real time updating, on the basis of OEF (operational exp. feedback). Address **all** components (civil, I&C, electric, etc.). A special coverage is needed for **digital I&C and software**

6. Consolidate the **ISI reliability approach** and develop guidelines for the RI ISI

7. Assess **ageing effects** in both overall deterministic and probabilistic safety assessment at the plant level : other networks APSA, NULIFE

Thank you!